

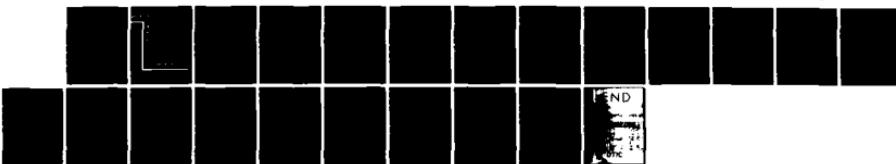
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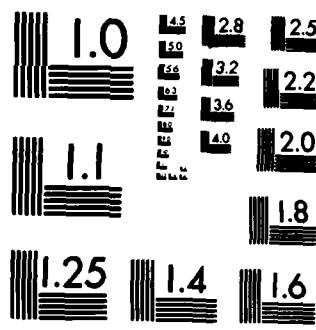
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OFFICER TRAINING SCHOOL SELECTION ALGORITHM

By

Lynn M. Scott, Captain, USAF

**MANPOWER AND PERSONNEL DIVISION
Brooks Air Force Base, Texas 78235**

October 1984

Final Report for Period November 1979 – May 1984

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This report has been reviewed and is approved for publication.

ANTHONY F. BRONZO, JR., Colonel, USAF
Commander

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<p>An application of the policy-specifying technique was used to develop a selection equation for the Air Force Officer Training School. The composite policy of representatives of seven Air Force agencies was modeled mathematically to produce a 100-point rating that is the synthesis of values from 13 selection factors. Tests using both simulated and actual case data revealed that the equation is an accurate model of Air Force policy and that the equation can successfully rank-order OTS applicants in a reliable and clearly specified manner.</p>			
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OFFICER TRAINING SCHOOL SELECTION ALGORITHM

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This is a Special Report prepared for the Air Training Command (ATC/XPTT and ATC/RSMD) and the Air Force Manpower and Personnel Center (AFMPC/MPCM).

EXECUTIVE SUMMARY

Background

Applicants to the Air Force Officer Training School (OTS) are currently evaluated by a selection board composed of senior Air Force officers. Based on experience with the board selection process, concern has been expressed about possible inconsistencies in judgment among members on the same board and among selection boards conducted at different times. This work was accomplished to develop a systematic procedure to overcome these difficulties, as outlined in the Request for Personnel Research (RPR) 79-03, Development of a General Purpose Selection and Classification Model for Officer Accessions in the Pipeline Management System.

Findings

A computer-based algorithm, based on the policy-specifying technique, was developed to model selection board decisions. A group of 14 policy experts was assembled to develop the algorithm. Thirteen relevant variables were operationally defined and combined into three major categories (military performance measures, civilian performance measures, objective cognitive measures). To resolve problems in interpretation of grade point averages (GPAs) from different academic institutions, a supplementary policy algorithm (the Patton rating) was developed to adjust GPAs based on the quality of the institution.

The overall value of the various combinations of attributes was expressed in the form of a 100-point OTS payoff scale. Every 5-point increment was anchored with an expected behavior characteristic of an OTS trainee or that of an active duty Air Force officer. The payoff scale was used at each stage in the hierarchy to maintain a consistent framework for eliciting policy judgments.

A consensus policy was developed on how various levels on the 13 variables could be numerically combined to represent an overall payoff value to the Air Force. The resulting model was checked for general consistency by comparing the applicant group ratings as determined by (a) the algorithm, (b) a mock selection board composed of policy experts, and (c) an actual OTS selection panel.

Conclusions

1. The selection algorithm developed as a product of RPR 79-03 provides a reliable and clearly specified procedure for rank-ordering OTS applicants. This algorithm was generally consistent with mock and OTS selection board procedures but did not represent an exact replication of either.
2. The OTS payoff scale provided a convenient point of reference for developing the policy model.
3. Procedures developed can be generalized to other situations where a single "order of merit" ranking based on multiple input variables is desired.

Recommendation

It is recommended that the computer algorithm be implemented as a part of the OTS applicant selection system.

PREFACE

This Special Report concludes the Air Force Human Resources Laboratory research and development (R&D) efforts in response to Request for Personnel Research (RPR) 79-03, Development of a General Purpose Selection and Classification Model for Officer Accessions in the Pipeline Management System. The R&D was accomplished under Work Unit 77192002.

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OFFICER TRAINING SCHOOL SELECTION ALGORITHM

I. BACKGROUND

Applicants for Officer Training School (OTS) are currently evaluated by a selection board composed of senior Air Force officers. Decisions about who is best qualified for entry are made on the basis of a review of the applicant's files, which typically include identifying data, application forms, educational transcripts, letters of recommendation, etc. Individual board membership varies over time. Eligible officers serve on the board on a voluntary basis.

Based on experience with the board selection process and with similar systems that have been used during the past in Reserve Officer Training Corps and Air Force Academy screening, concern has been expressed about possible inconsistencies in judgment among members on the same board and among selection boards conducted at different times. The main problem seems to stem from the necessity for evaluating an overwhelming amount of relevant information on each applicant, the absence of clear-cut standards, and the subjective nature of the evaluation process. The need to develop a systematic procedure to overcome some of these difficulties was documented in a Request for Personnel Research (RPR) jointly sponsored by the Air Training Command (ATC) and the Air Force Manpower and Personnel Center (AFMPC) (RPR 79-03, Development of a General Purpose Selection and Classification Model for Officer Accessions in the Pipeline Management System). This work was accomplished in support of that requirement.

II. FINDINGS

A computer-based algorithm was developed to model selection board decisions based on the policy-specifying technique (Ward, 1977; Ward, Pina, Fast, & Roberts, 1979). Policy specifying requires the identification of policy experts, selection of relevant variables, combination of variables in a pair-wise hierarchy, and assignment of payoff values at each stage of the hierarchy representing overall benefit to the Air Force. Since the objective was to improve OTS selection board procedures rather than to duplicate them, techniques such as judgment analysis (Christal, 1968a) or policy capturing (Christal, 1968b) were not considered appropriate. A group of 14 policy experts was assembled from various offices in ATC and AFMPC for purposes of developing the algorithm. Variables appropriate for selecting Air Force officers were identified via questionnaires completed by policy experts. Thirteen relevant variables were operationally defined and combined into three major categories to serve as a framework for decision making. The categories were: (a) objective cognitive measures, (b) military performance measures, and (c) civilian performance measures (Figure 1). The variables are defined in more detail in Appendix B. College grade point average (GPA) presented special problems in interpretation because of the known variability in institutional quality (Astin, 1965; Bryden, 1981). A GPA of 3.5 from a highly selective school may not reflect the same achievement level if obtained at a less selective school. A supplementary policy algorithm, termed the Patton Rating, was developed in parallel with the selection algorithm to "adjust" GPAs based on the quality of the institution at which they were received. Details of this rating system are given in Appendix C.

The overall value of the various combinations of attributes was expressed in the form of a 100-point OTS payoff scale. Every five-point increment was anchored with an expected behavior characteristic of an OTS trainee or that of an active duty Air Force officer as shown in Appendix A. Anchors were developed using the procedure detailed in Campbell, Dunnette, Arvey, and Hellervik (1973). The payoff scale was used at each stage in the hierarchy to maintain a consistent framework for judgment.

The group of policy experts met in weekly 3-hour sessions over the period of several months to develop a consensus policy on the selection measures. Agreement was reached on how various levels on the 13 variables could be numerically combined to represent an overall payoff value to the Air Force (Figure 1). Most of the pair-wise combinations of variables and functions are relatively straightforward. There are two switching mechanisms in the hierarchy. The first (S1) is set to reflect whether the applicant has recent prior military service data. If not, information from the recruiter evaluation, non-military awards, and non-military achievements becomes the primary basis for assessment. If the applicant had prior military service, the second switch (S2) is set according on the amount of service. The policy board decided that the evaluation of a person's military performance should be contingent on the length of prior military service. For a given applicant, only one of the following functions is applied:

**OBJECTIVE COGNITIVE
MEASURES PROFILE**

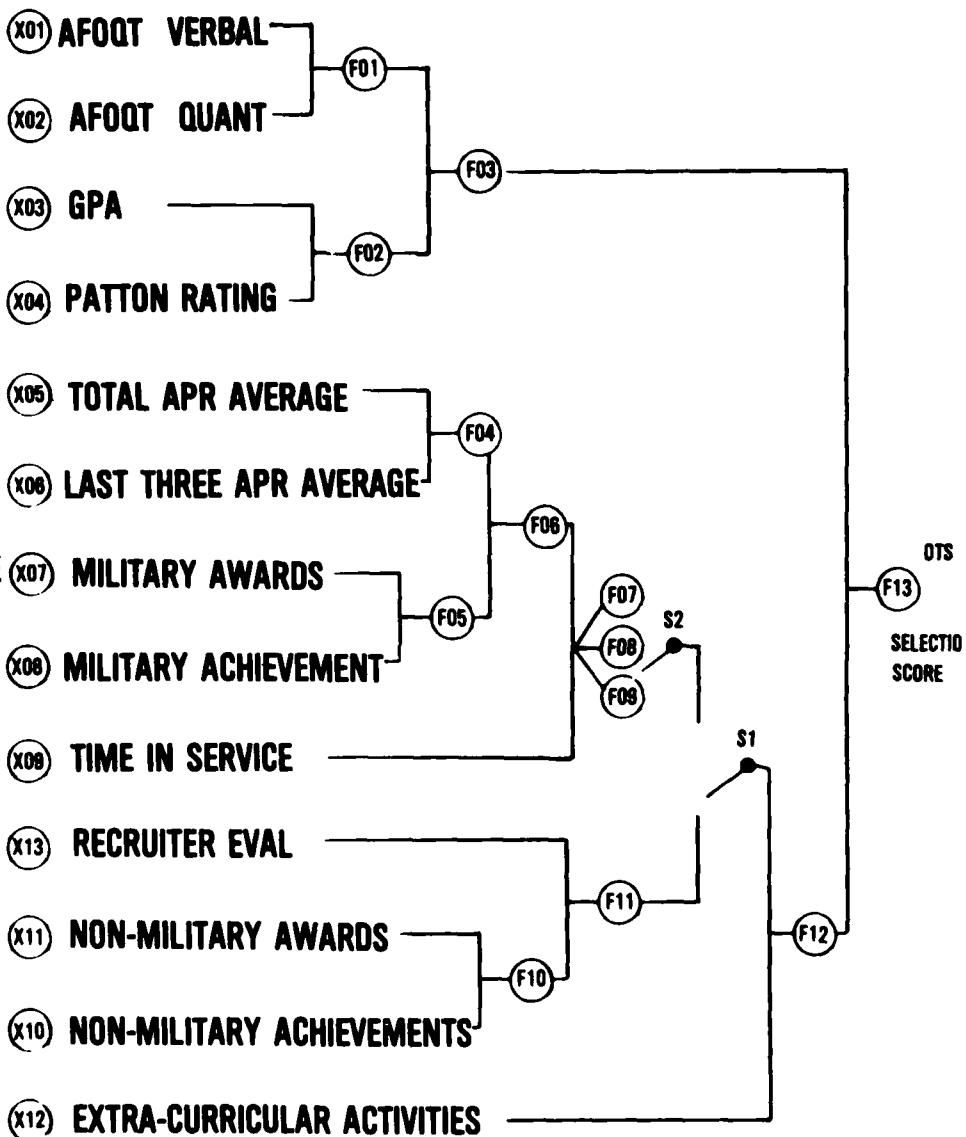


Figure 1. The Officer Training School Selection Hierarchy.

1. F07 if 0 to 4 years military service
2. F08 if 5 to 7 years
3. F09 if 8 to 15 years

To illustrate the operation of the functions in the hierarchy, Table 1 shows the payoff values associated with all pair-wise combinations of the output from functions F03 and F12. F03 summarizes the applicant's performance on the objective cognitive measures (i.e., AFOQT and GPA), and F12 indicates either the applicant's prior military performance or participation/leadership roles in civilian life. (See discussion of S1 in the previous paragraph.) Function F13, shown in the table, indicates that an applicant with the highest level of performance on the cognitive measures (F03 = 100) begins with a final payoff score of 30 if F12 has a value of ≤ 15 . For each 5-point increase in F12, the applicant gains approximately 4 final points up to a maximum of 100 when F12 = 100.

**Table 1. Final Payoff Matrix for the OTS Selection
Algorithm – Function 13**

		Function 13																	
		15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
Function 12		15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
100		30	34	38	42	46	51	55	59	63	67	71	75	79	84	88	92	96	100
95		30	34	38	42	46	51	55	59	63	67	71	75	79	84	88	92	96	100
90		30	34	38	42	46	51	55	59	63	67	71	75	79	84	88	92	96	100
85		30	34	38	42	46	51	55	59	63	67	71	75	79	83	88	92	96	100
80		30	34	38	42	46	51	55	59	63	67	71	75	79	83	88	92	96	100
75		30	34	38	42	46	50	55	59	63	67	71	75	79	83	87	91	96	100
70		30	34	38	42	46	50	54	58	62	67	71	75	79	83	87	91	95	99
65		30	34	38	42	46	50	54	58	62	66	70	74	78	82	86	91	95	99
60		29	33	37	41	45	49	53	57	61	65	70	74	78	82	86	90	94	98
55		29	33	37	41	45	49	53	57	61	65	68	72	76	80	84	88	92	96
50		28	32	36	40	44	48	52	55	59	63	67	71	75	79	83	87	90	94
45		27	31	35	39	42	46	50	54	58	61	65	69	73	77	80	84	88	92
40		26	30	33	37	41	44	48	52	55	59	63	66	70	74	77	81	85	88
35		25	28	32	35	39	42	46	49	53	56	60	63	66	70	73	77	80	84
30		23	26	29	33	36	39	42	46	49	52	55	59	62	65	69	72	75	78
25		21	24	27	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72
20		18	20	23	26	28	31	34	36	39	42	44	47	50	52	55	58	60	63
15		14	17	19	21	23	26	28	30	33	35	37	39	42	44	46	48	51	53
10		10	12	14	16	18	19	21	23	25	27	28	30	32	34	36	37	39	41
5		6	7	8	9	11	12	13	14	16	17	18	19	20	22	23	24	25	27
0		0	1	1	2	2	3	4	4	5	5	6	6	7	8	8	9	9	10

An applicant at the lowest level of cognitive performance (F03 = 0) begins with a final point value of 0 and gains approximately 1/2 point for each 5-point increment in F12, up to a maximum of 10 final points. Reading down the columns (at fixed levels on F12), it can be noted that there is no effect on final point values as performance on the cognitive measures decreases until F03 = 75, after which final point values decrease more rapidly.

After the complete policy had been modeled, it was checked for general consistency by comparing the applicant group ratings determined by (a) the algorithm, (b) a mock selection board composed of policy experts, and (c) an actual OTS selection panel. Rank order correlations among the three scoring systems were computed. The correlation between the algorithm and the OTS selection board was .37. Correlation between the algorithm's ranking and that of the mock board was .52 and between the mock board and the OTS panel, .55.

III. CONCLUSIONS

1. The selection algorithm developed in this effort provides a reliable and clearly specified procedure for rank-ordering OTS applicants based on consensus judgments of Air Force policy-makers.
2. The computer-based algorithm is generally consistent with "mock" and "actual" OTS selection board procedures but does not exactly replicate either. This is because the algorithm incorporates a wide variety of information in a complex yet consistent manner, thereby eliminating problems with instability of ratings within and among selection boards.
3. The OTS payoff scale provides a convenient point of reference for developing the policy model.

IV. APPLICATIONS

The computer algorithm can be applied directly to selecting OTS applicants, with only a modest investment in clerical processing, data input resources, and a small microcomputer. A prudent course of action would include the simultaneous use of regular board selection procedures cross-checked over a period of time with the corresponding selections made by the computer algorithm. Any obvious and unresolved inconsistencies would serve as a basis for further refinement of the computer algorithm. Another alternative would be to combine the computer algorithm score with that produced by the selection board into a higher-order policy model.

Incorporation of the computer-based algorithm into OTS selection procedures would be expected to result in higher overall quality of selectees over time by minimizing the chance that lesser qualified applicants would be selected due to inconsistencies in selection procedures. Benefit would also accrue by having Air Force selection policy stabilized in the form of the algorithm.

Instruments and procedures used in this effort may be of use in other situations where a single "order of merit" ranking based on multiple, and possibly incommensurate, input variables is desired.

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APPENDIX A: OTS PAYOFF SCALE

Table A-1. OTS Payoff Scale

Payoff Value	Anchor Statement
0 –	Flunks out of OTS immediately.
5 –	Would be a liability to the Air Force; refuses to do as directed; won't even try.
10 –	Has no initiative; is poor performer; has little motivation and no leadership characteristics; has academic difficulties in OTS and is recycled.
15 –	Has no initiative or creativity; has a good chance of failing OTS.
20 –	Has occasional poor scores in OTS academic and performance evaluations.
25 –	Is reluctant to assume any leadership responsibilities; displays initiative infrequently.
30 –	Would not accept leadership positions; has a "why" attitude, but would graduate; performs duties with encouragement but needs help in training.
35 –	Is well motivated initially upon receiving commission but drops off to below-average motivation.
40 –	Meets standards but needs supervision.
45 –	Is motivated for some but not all aspects of assigned tasks.
50 –	Has average performance at OTS.
55 –	Has average performance in academics and military bearing at OTS.
60 –	Shows some initiative; would finish tasks in the time allotted; should be able to complete OTS and most technical schools.
65 –	Completes assignments to best ability; helps others with tasks.
70 –	Has good leadership potential.
75 –	Frequently outperforms peers; would help train others and seek extra duties.
80 –	Is natural performer in OTS, almost Distinguished Graduate (DG).
85 –	Completes training rapidly and seeks additional information about tasks.
90 –	Needs no supervision.
95 –	Is very aggressive, goal oriented, creative, and highly motivated.
100 –	Is dynamic, self starter; Honor Graduate.

**APPENDIX B: OTS SELECTION ALGORITHM:
VARIABLE DEFINITIONS AND EQUATIONS**

Table B-1. OTS Selection Algorithm: Variables and Definitions

Variable Name	Definition
AFOQT Verbal (X01)	The verbal subtest percentile score of the Air Force Officer Qualifying Test.
AFOQT Quant. (X02)	The quantitative subtest percentile score of the Air Force Officer Qualifying Test.
GPA (X03)	The applicant's undergraduate college grade point average reported on a four-point scale (A = 4, B = 3, C = 2, D = 1).
Patton Rating (X04)	The quality index of the applicant's undergraduate institution as a function of Scholastic Aptitude Test (SAT), Admission Ratio, Percent Graduate and Professional Students, and Percent of Faculty with PhD or Professional Degrees: measured on a 10-point scale (10 = highest rating) and reported to two significant digits. (See Appendix C)
Total APR Average (X05)	The average of all the <i>overall</i> Airman Performance Report ratings since applicant enlisted.
Last three APR Average (X06)	The average of the three most recent overall Airman Performance Report ratings for the applicant.
Military Awards (X07)	Military decorations and awards (e.g., Medal of Honor, Air Force Cross, Distinguished Service Cross, Distinguished Service Medal, Silver Star, Legion of Merit, Distinguished Flying Cross, Airman's Medal, Soldier's Medal, Bronze Star Medal, Meritorious Service Medal, Air Medal, Joint Service Commendation Medal, Air Force Commendation Medal, Army Commendation Medal, Purple Heart, Outstanding Airman of the Year Ribbon, Air Force Achievement Medal, Basic Military Trainee Distinguished Graduate Ribbon). Each decoration has the same point value as reported in the Weighted Airman Promotion System (WAPS) portion of the Military Training Standard (MTS) Promotion Fitness Examination (PFE) Study Guide (AFP 50-34).
Military Achievements (X08)	Includes achievement as a distinguished graduate of a military training program, selection as the outstanding airman or noncommissioned officer of the quarter of the year for a wing level or higher organization. Each distinction is worth one point.
Time in Service (X09)	The total active Federal military service reported in decimal values.
Recruiter Eval (X13)	The numerical evaluation provided by the field recruiting officer after completing an interview with the applicant. Reported through the 100-point OTS payoff scale.
Non-Military Awards (X11)	Includes receipt of an outstanding employee award, any award or honor related to a civic activity, the Outstanding Young Man in America Award or the Outstanding Young Woman in America Award, and membership in the following national honor societies: Alpha Epsilon Delta, Alpha Kappa Delta, Alpha Lambda Delta, Alpha Pi Mu, Chi Epsilon, Delta Sigma, Eta Kappa Nu, Kappa Delta Pi, Omega Chi Epsilon, Omicron Delta Epsilon, Omicron Nu, Phi Alpha Theta, Phi Beta Kappa, Phi Eta Sigma, Phi Kappa Phi, Pi Delta Phi, Pi Epsilon Alpha, Pi Tau Epsilon, Psi Chi, Rho Chi, Sigma Delta Pi, Sigma Gamma Tau, Sigma Pi Sigma, Sigma Tau Delta, Tau Beta Pi, and Xi Sigma Pi. Each award or society membership is worth one point.

Table B-1. (Continued)

Variable Name	Definition
Non-Military Achievements (X10)	Includes holding elective office to any of the following organizations: Sports Club; Student Judicial System; Living Group; Clubs; Professional Organizations/Societies; Service Organizations; Religious Organizations; Organizations Control Board; Student Government; Fraternities/Sororities; Debate Team; National Honor Society; National Recognition Societies; the Parent-Teachers Association; Sports League Coach; Religious Youth League; Religious Adult Organization; holding a position of Scouting Leader or Director; Varsity Sports Captain; Varsity Sports Manager; Drill Team Captain; Organizer of a College Political Group or Campaign; Editor or Feature Writer for a collegiate paper, annual, magazine or anthology; Choir Director; Drill Team Member; Member of Omicron Delta Kappa; Member of Lambda Sigma; Member of Molar Board; Campus Radio Station Manager. Membership in the following national recognition societies: Alpha Epsilon Rho, Alpha Eta Rho, Alpha Phi Omega, Alpha Psi Omega, Alpha Zeta, Block and Bridle, Delta Sigma Pi, Gamma Sigma Sigma, Kappa Psi, Lambda Tau, Omicron Kappa Pi, Phi Chi Theta, Phi Delta Kappa, Phi Delta Chi, Phi Lambda Epsilon, Phi Mu Alpha, Phi Psi, Phi Zeta, Pi Alpha, Pi Mu Epsilon, Sigma Gamma Epsilon, Sigma Lambda Chi. Each position or membership counts as one point.
Extra-Curricular Activities (X12)	Membership in the following organizations: Sports Club, Living Group, Clubs (other than a sports club), professional organizations/societies, service organizations, religious organizations, organizations control board, fraternities/sororities, and the debate team. Each organizational membership is worth one point.

Table B-2. OTS Selection Algorithm: Equations

Function	Equation
F01 =	$90 - 0.001108(X01 - 95)^2 - 0.003556(X02 - 75)^2 - 0.0000008564(X01 - 95)^2(X02 - 75)^2$
F02 =	$0.2(X03 - 200) + 6.5(X04) - 0.0025(X03 - 200)(X04)$
F03 =	$0.45(F01) + 0.55(F02)$
F04 =	$0.00125(X06 - 700)^2 + 0.00000003125(X05 - 700)^2(X06 - 700)^2$
F05 =	$35 + 1.5(X07) + 2.05(X08) - 0.1(X07)(X08)$
F06 =	$0.000001(F04)^3 - 0.0000000003889(F04)^4(F05 - 65)^2$
F07 =	$25 - 5(X09 - 1) + 0.0003768(F06)^{2.3} + 0.00004605(X09 - 1)(F06)^{2.3}$
F08 =	$0.3704(X09 - 7)^3 + 0.002512(F06)^{2.3} + 0.00002791(X09 - 7)^4(F06)^{2.3}$
F09 =	$100 - 0.9375(X09 - 7)^2 - 0.01(F06 - 100)^2 + 0.00009375(X09 - 7)^2(F06 - 100)^2$
F10 =	$35 + 1.5(X10) + 2.5(X11) - 0.1(X10)(X11)$
F11 =	$100 - 0.01(X13 - 100)^2 - 0.03889(F10 - 65)^2 + 0.000003889(X13 - 100)^2(F10 - 65)^2$
F12 =	$15 + 1.133(F14 - 25) + X12 - 0.01333(F14 - 25)(X12)$
F13 =	$30 - 0.0000003(F03 - 100)^3 + 0.8235(F12 - 15) - 0.000000007059(F03 - 100)^3(F12 - 15)$

Note. In Function F12, F14 takes on the value of F11 if the applicant has no recent military service; F07 if the applicant has 0-4 years of prior service; F08 if 5-7 years; or F09 if 8-15 years.

**APPENDIX C: PATTON RATING: HIERARCHY, VARIABLE
DEFINITIONS, AND EQUATIONS**

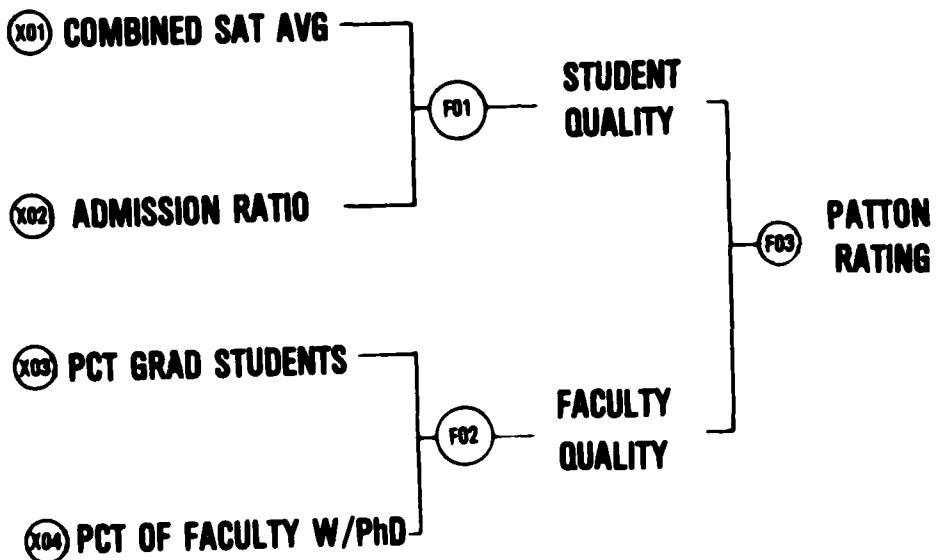


Figure C-1. Patton rating hierarchy.

Table C-1. Patton Rating: Variable Definitions

Variable Name	Definition
Combined SAT Average (X01)	Average combined SAT scores for entering freshmen.
Admission Ratio (X02)	Proportion of selectees to total applicants.
Percentage Graduate Students (X03)	Percentage of graduate students in the total student body.
Percentage Faculty w/PhD (X04)	Percentage of total faculty with doctorate degrees.

Table C-2. Patton Rating: Equations

Function	Equation
F01 =	$100 - 0.000095(X01 - 1400)^2 - 0.001772(X02 - 8)^2 + 0.000000001181(X01 - 1400)^2(X02 - 8)^2$
F02 =	$90 + 0.001(X03)^2 - 0.0085(X04 - 100)^2 + 0.00000035(X03)^2(X04 - 100)^2$
F03 =	$0.85(F01) + 0.05(F02) + 0.001(F01)(F02)$

END

FILMED

11-84

DTIC